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35617	7590	10/31/2003	EXAMINER PHAM, THANHHA S	
CONLEY ROSE, P.C. P.O. BOX 684908 AUSTIN, TX 78768			ART UNIT 2813	PAPER NUMBER

DATE MAILED: 10/31/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/661,666

Applicant(s)

QIAO ET AL.

Examiner

Thanhha Pham

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 August 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5, 7-12, 14-16 and 28-33 is/are pending in the application.
- 4a) Of the above claim(s) 28-33 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 7-12, 14-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This Office Action responses to Applicant's Amendment in Paper No. 15 dated 8/25/03.

Election/Restrictions

1. Newly submitted claims 28-33 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: Claims 28-33 drawn to distinct species to the originally elected species of claims 1-16.

- The originally elected species of claims 1-16 is drawn to a method for forming a semiconductor device comprising etching a first portion of a dielectric layer formed on the semiconductor topography with a first etch chemistry wherein the first etch chemistry is substantially free of hydrogen and comprises C₄F₈; and etching a second portion of the dielectric layer with a second etch chemistry different from the first etch chemistry wherein the first and second etch chemistries are selective to silicon nitride, wherein the second etch chemistry has a dielectric material : silicon oxide selectivity of at least approximately 5:1 and wherein the dielectric layer comprises the dielectric material.
- Newly submitted species of claims 28-30 is drawn to a method for processing a semiconductor topography comprising etching a first portion of a dielectric layer formed on a semiconductor topography with a first etch chemistry wherein the first etch chemistry is substantially free of hydrogen and comprises fluorinated

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carbon compounds and chlorinated carbon compounds; and etching a second portion of the dielectric layer with a second etch chemistry different from the first chemistry wherein the first and second etch chemistries are selective to silicon nitride.

- Newly submitted species of claims 31-33 is drawn to a method for processing a semiconductor topography comprising etching a first portion of a dielectric layer formed on a semiconductor topography with a first etch chemistry substantially free of hydrogen; and etching a second portion of the dielectric layer with a second etch chemistry different from the first chemistry wherein the first and second etch chemistries are selective to silicon nitride, and wherein the second etch chemistry comprises fluorinated carbon compounds and chlorinated carbon compounds.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 28-33 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-5, 7-12 and 14-16 rejected under 35 U.S.C. 103(a) as being unpatentable over Ko [US 6,337,285] in view of Ko et al [US 6,117,791].

➤ With respect to claims 1-2, 11 and 15, Ko (figs 1, 3-5 and col 1-8) discloses the claimed method for forming a semiconductor device comprising steps of:

forming a dielectric layer (24, fig 3, col 5 lines 29-61) on a semiconductor topography in one processing step *[claim 11]*, wherein the semiconductor topography comprises a gate structure (30, col 5 lines 41-48) formed on a semiconductor layer (12), wherein the semiconductor layer comprises isolation regions (14, figs 3 and 1, col 6 lines 34-43 and col 2 lines 20-49) and wherein the dielectric layer (24, fig 3) is in contact with a sidewall spacer (32) of the gate structure (30) and the semiconductor layer (12) *[claim 15]*, said dielectric layer is substantially continuous *[claim 2]*;

etching a first portion of the dielectric layer (fig 4, col 5 lines 62-67 and col 6 lines 1-22, particularly col 5 lines 65-67 and col 6 lines 1, 11-16 & 21-22) formed on the semiconductor topography with a first etch chemistry, wherein the first etch chemistry is substantially free of hydrogen and comprises C_4F_8 (col 6 lines 11-16) *[claim 1]*; and

etching a second portion of the dielectric layer (fig 5, col 6 lines 36-57) with a second etch chemistry different from the first etch chemistry, wherein the first and second etch chemistry are selective to silicon nitride *[claim 1]*.

Ko is silent about the etch selectivity of the second etch chemistry wherein the second etch chemistry has a dielectric material: silicon oxide selectivity of at least approximately 5:1 wherein the dielectric layer comprises the dielectric material *[claim 1]*. Instead, Ko (col 6 lines 34-38 and lines 47-51) generally teaches the second etch

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chemistry is selective to silicon oxide (etching the second portion of the dielectric layer selectively to silicon oxide of field oxide regions 14).

However, the claimed selectivity of the second etch chemistry of the dielectric material of the dielectric layer: silicon oxide of at least approximately 5:1 is considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted In re Aller 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

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- With respect to claim 3, Ko ('285), figs 3-4, teaches an interface does not exist between the first and second portions of the dielectric layer.
- With respect to claim 4, Ko ('285), figs 4-5, teaches a thickness of the first portion of the dielectric layer is greater a thickness of the second portion of the dielectric layer.
- With respect to claim 5, Ko ('285), fig 4, teaches a thickness of the second portion of the dielectric layer is greater than approximately one half of a height of the gate structure.
- With respect to claim 7, Ko ('285), col 6 lines 18-19, teaches the first etch chemistry comprises CO.
- With respect to claim 8, Ko ('285), col 6 lines 34-57, teaches the second etch chemistry comprises at least one hydrogen-containing compound.
- With respect to claim 9, Ko ('285) substantially discloses the claimed method comprising steps of etching the substantially continuous dielectric layer of doped silicon oxide using the first etch chemistry and the second etch chemistry except teaching the second etch chemistry comprising $C_2H_2F_4$.

However, $C_2H_2F_4$ is a well-known etchant material to etch dielectric materials. $C_2H_2F_4$ is a well-known material which has been used to improve etching selectivity while etching a dielectric layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.* , 325 U.S. 327, 65 USPQ 297 (1945).

Moreover, Ko ('791) teaches that $C_2H_2F_4$ is an improved etchant to etch a dielectric layer of doped silicon oxide selectively to both undoped silicon oxide and silicon nitride. It would have been obvious for those skilled in the art to modify the process of Ko ('285) by using the second etch chemistry comprising $C_2H_2F_4$ as being claimed, per taught by Ko et al ('791), to form an improved self-aligned contact with a better-control-etching process to make a better device.

- With respect to claim 10, Ko ('285), col 6 lines 52-57, teaches the second etch chemistry comprises CHF_3 .
- With respect to claim 12, the selectivity of the first etch chemistry of a dielectric material: silicon nitride of at least approximately of 10:1 wherein the dielectric layer comprising the dielectric material is considered to involve routine involve optimization while has been held to be within the level of ordinary skill in the art. See *In re Aller* 105 USPQ233, 255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).
- With respect to claim 14, Ko, ('285), col 5 lines 49-52, teaches the dielectric layer (BSG) comprises a doped silicon oxide having a phosphorous concentration of less than approximate 6 wt. %.
- With respect to claim 16, Ko ('285), figs 4-5, teaches etching the first portion of the dielectric layer exposes an upper corner of the sidewall spacer (18, fig 4) and

etching the second portion of the dielectric layer exposes the semiconductor layer (12, fig 5).

3. Claims 1-5, 7-8, and 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al [US 6,025,255] in view of Sung et al [US 5,631,179] and Yanagida [US 5,314,575].

➤ With respect to claims 1-2 and 11, Chen et al, figs 4's and col 1-6, discloses a method for forming a semiconductor device comprising steps of:

forming a dielectric layer (28, fig 4D, col 5 lines 24-35) on a semiconductor topography in one processing step *[claim 11]*, said dielectric layer is substantially continuous *[claim 2]*;

etching a first portion of the dielectric layer (fig 4E, col 5 lines 38-58) formed on the semiconductor topography with a first etch chemistry, wherein the first etch chemistry comprises C_4F_8 *[claim 1]*; and

etching a second portion of the dielectric layer (fig 4F, col 6 lines 9-24) with a second etch chemistry different from the first etch chemistry, wherein the first and second etch chemistry are selective to silicon nitride *[claim 1]*.

Chen et al does not teach: **a)** etching said first portion of the dielectric layer with the first etch chemistry substantially free of hydrogen; and **b)** the second etch chemistry has a dielectric material: silicon oxide selectivity of at least approximately 5:1 wherein the dielectric layer comprises the dielectric material.

Regarding to **a)**, using etch chemistry substantially free of hydrogen to etch the dielectric layer selectively to the silicon nitride has been known in the art. See Sung et

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al (figs 2G-2H and col 6 lines 16-63) as an evidence which shows using the etch chemistry substantially free of hydrogen to etch the dielectric layer (30) selectively to silicon nitride. Moreover, Yanagida teaches etching the substantially continuous dielectric layer using a two-step etching wherein the first step of etching using the first etch chemistry substantially free of hydrogen to etch the first portion of the substantially continuous dielectric layer with a high rate of etching. Therefore, it would have been obvious for those skilled in the art to modify the process of Chen et al by using the first etch chemistry substantially of hydrogen as being claimed, per taught by Sung et al and Yanagida, to etch the first portion of the dielectric layer to form a better semiconductor device with low production cost (high production speed by increasing etch rate) and better quality (good selective etching for a better control production process thereby forming a better device).

Regarding to **b)**, the claimed selectivity of the second etch chemistry of the dielectric material of the dielectric layer: silicon oxide of at least approximately 5:1 is considered to involve routine involve optimization while has been held to be within the level of ordinary skill in the art. See *In re Aller* 105 USPQ233, 255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

➤ With respect to claim 3, Chen et al (fig 4D) teaches an interface does not exist between the first and second portions of the dielectric layer.

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➤ With respect to claims 8 and 10, Chen et al (col 6 lines 9-15) teaches the second etch chemistry comprises at least one hydrogen containing compound of CHF_3 .

➤ With respect to claims 4, 5, 12, 14, ranges thicknesses of the first and second portions of the dielectric layer, ranges of relative etch selectivity and range of dopant concentration of phosphorous in the dielectric layer are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted In re Aller 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious. See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935).

- With respect to claim 7, CO is a known etchant for etching dielectric materials. See Sung et al as an evidence that show using CO etchant. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "*Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle.*" (65 USPQ at 301.)

4. Claims 9 and 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al [US 6,025,255] in view of Sung et al [US 5,631,179] and Yanagida [US 5,314,575] as applied to claim 1 above, and further in view of Ko et al [US 6,117,791].

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➤ With respect to claim 9, Chen et al in view of Sung et al and Yanagida substantially discloses the claimed method except teaching that the second etch chemistry comprises $C_2H_2F_4$.

However, $C_2H_2F_4$ is a known etchant for etching the dielectric layer. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." (65 USPQ at 301.) Moreover, Ko et al discloses using $C_2H_2F_4$ as an etchant to improve etch selectivity when etching the dielectric layer.

Therefore, it would have been obvious for those skilled in the art to modify the process of Chen et al in view of Sung et al and Yanagida by using the second etch chemistry comprising $C_2H_2F_4$ as being claimed, per taught by Ko et al, to improve the etch selectivity in etching the dielectric layer for a better control in forming a semiconductor device.

➤ With respect to claims 15 and 16, Chen et al in view of Sung et al and Yanagida substantially discloses the claimed method including using the semiconductor topography comprising a gate structure (26, fig 4D) formed on a semiconductor layer (10) wherein the dielectric layer (28) is in contact with a sidewall spacer (27) of the gate structure and the semiconductor layer (10) **[claim 15]**. Chen et al in view of Sung et al and Yanagida also discloses etching the first portion of the dielectric layer exposes an

upper corner of the sidewall spacer and etching the second portion of the dielectric layer exposes the semiconductor layer *[claim 16]*.

Chen et al in view of Sung et al and Yanagida does not expressly teaches the semiconductor layer comprising isolation regions *[claim 15]*.

Ko et al (fig 1) discloses the semiconductor layer (12) comprises isolation regions (14).

Therefore, it would have been obvious for those skilled in the art to modify the process of Chen et al in view of Sung et al and Yanagida by using the semiconductor layer comprising isolation regions as taught by Ko et al to define active regions in the semiconductor device as a demand of a device is needed.

Response to Arguments

5. Applicant's arguments filed 8/25/03 have been fully considered but they are not persuasive.

➤ With respect to Applicant's argument on page 6, Applicant argues that Ko does not explicitly teach etching the dielectric layer with an etch chemistry which is absent of hydrogen. The argument is not persuasive because Ko ('285) teaches the first etch chemistry can be either with or without hydrogen (see Ko ('285): col 6 lines 11-22). Although Ko teaches that CH₂F₂ **may be** added to CxF_y gas, the addition of CH₂F₂ is optional. Moreover, Ko recognizes that CxF_y (fluorocarbon substantially free of hydrogen) primarily used to etch the dielectric layer selectively to silicon nitride. Ko (col 6 lines 11-16) discloses the first etch chemistry uses "....a first process gas that comprises

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a mixture of C_xF_y ($x>1$) type gas and a dilute gas such as Ar. The C_xF_y gas can be selected from but not limited to C_4F_8 , C_4F_6 , or C_5F_8 . For example, the first process gas could be a gas mixture with a flow rate of 10 sccm of C_4F_8 and 500 sci of Ar.... The nitride selectivity is primarily determined by the C_xF_y ($x>1$) gas.” Clearly, Ko teaches the first etch chemistry can be comprised of C_4F_8 and substantially free of hydrogen as being claimed -- For example, the first process gas could be a gas mixture with a flow rate of 10 sccm of C_4F_8 and 500 sci of Ar (see Ko, col 6 lines 14-16).

➤ With respect to Applicant's argument on pages 7-8, Applicant argues that none of cited prior art discloses etch selectivity between the dielectric material being etched and an underlying layer of silicon oxide and it would not be obvious for those skilled in the art to create the etch chemistry with a dielectric material:silicon oxide selectivity of at least 5:1 by routine optimization. The argument is not persuasive because:

- a) Applicant does not claim the selectivity between the dielectric material being etched and an underlying layer of silicon oxide.
- b) Ko ('285) discloses etch selectivity between the dielectric material being etched (layer 24, fig 4-5, col 6 lines 36-38) and silicon oxide (of field oxide region 14). It would be obvious for those skilled in the art to create the etch chemistry with a dielectric material:silicon oxide selectivity of at least 5:1 by routine optimization in the process of Ko.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached on (703) 308-4940. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham


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